Remarks

In view of the above amendments and the following remarks, reconsideration of the rejections and further examination are requested.

Initially, it is noted that withdrawn claims 24-26 have been canceled without prejudice or disclaimer to the subject matter contained therein.

Claims 1-4, 7, 12 and 13 have been rejected under 35 U.S.C. §103(a) as being unpatentable over Ikeda (US 6,285,768) in view of Zhang (US 7,181,026).

Claim 1 has been amended so as to further distinguish the present invention, as recited therein, from the references relied upon in the rejection. These amendments include adding features similar to those previously recited in claim 12. Therefore, claim 12 has been cancelled without prejudice or disclaimer to the subject matter contained therein.

The above-mentioned rejection is respectfully traversed and submitted to be inapplicable to the claims for the following reasons.

Claim 1 is patentable over the combination of Ikeda and Zhang, since claim 1 recites a microphone device including, in part:

a signal generating section for generating a main signal indicative of a result obtained through detection with a sensitivity in the direction of the target sound and a noise reference signal indicative of a result obtained through detection with a sensitivity higher in another direction than in the direction of the target sound by orienting a direction of minimum sensitivity to the direction of the target sound;

a subtracting section for canceling a signal component of the target sound included in the noise reference signal by subtracting a signal generated by an adaptive filter section from the noise reference signal generated by the signal generating section;

an adaptive filter section including an adaptive filter, the adaptive filter section for generating a signal indicative of a signal component of the target sound included in the noise reference signal generated by the signal generating section by performing, by the adaptive filter, a filtering process on the main signal generated by the signal generating section, and for learning a filter coefficient only when the determining section determines that the level ratio is larger than the predetermined value; and

a noise suppressing section for suppressing a signal component of noise included in the main signal by using the main signal and the noise reference signal after subtraction by the subtracting section, wherein

the noise suppressing section includes:

a noise suppression filter coefficient calculating section for calculating, based on a power spectrum of the main signal and a power spectrum of the noise reference signal after subtraction by the subtraction section, a filter coefficient of the noise suppression filter for suppressing the signal component of the noise included in the main signal; and

a time-variant coefficient filter section for causing the main signal to be subjected to the filtering process at the noise suppression filter by reflecting the filter coefficient calculated by the noise suppression filter coefficient calculation section. The combination of Ikeda and Zhang fails to disclose or suggest these features of claim 1.

Ikeda discloses a noise cancelling unit designed to suppress noise and interference for a microphone. The noise cancelling unit includes a subtracter 5 that subtracts a pseudo signal component r(k) from a received (i.e., speech) signal y(k) to cancel a background noise signal from the speech signal y(k). The speech signal y(k) has been delayed in a delay circuit 3 prior to entering the subtracter 5. Further, the pseudo signal component r(k) is generated by an adaptive filter 4 that filters a reference noise signal x(k). (See column 1, line 47 – column 3, line 67 and Figures 2 and 3).

In the rejection, the speech signal y(k) is relied upon as corresponding to the noise reference signal and the reference noise signal x(k) is relied upon as corresponding to the main signal. Regarding this, it is apparent from the disclosure in Ikeda that the main signal of claim 1 actually corresponds to the speech signal y(k) of Ikeda and the noise reference signal of claim 1 corresponds to the reference noise signal x(k) of Ikeda. Further, the interpretation of Ikeda that the reference noise signal x(k) corresponds to the main signal and not the noise reference signal of claim 1 completely ignores the actual designation of the signal x(k) as the reference noise signal x(k). Therefore, contrary to the assertion in the rejection, the speech signal y(k) of Ikeda does not correspond to the noise reference signal and the reference noise signal x(k) of Ikeda does not correspond to the main signal.

Also in the rejection, the subtracter 5 is relied upon as corresponding to the claimed subtracting section. The subtracter 5 is disclosed in Ikeda as subtracting the pseudo signal

component r(k) from the speech signal y(k), and therefore is distinctly different in structure and function from the subtracting section of claim 1, which subtracts the main signal from the noise reference signal. If, as asserted in the rejection, the subtracter 5 corresponds to the subtracting section of claim 1, Ikeda would not be capable of suppressing noise.

Based on the disclosure of Ikeda at column 2 lines 4-9 and as compared to claim 1, the subtracter 5 of Ikeda potentially could be relied upon as corresponding to the noise suppressing section. Further, in view of removing the effect of the main signal from the noise reference signal, the adaptive filter 4 of Ikeda could potentially be relied upon as corresponding to the subtracting section. However, even under this interpretation, Ikeda fails to disclose or suggest the adaptive filter as recited in claim 1.

The subtracting section of claim 1 and the adaptive filter 4 of Ikeda will be compared to each other below. Ikeda discloses the use of the speech signal y(k) (which corresponds to the main signal of the present invention) for generating a control signal for changing filter coefficients of the adaptive filter 4. In contrast, the subtracting section of claim 1 subtracts the main signal after the filtering process by the adaptive filter section, i.e., an actual signal, from the noise reference signal. That is, claim 1 is distinctly different from Ikeda in the process of removing the effect of the main signal from the noise reference signal. Therefore, Zhang must address all of the deficiencies of Ikeda in order for the combination of these references to render claim 1 obvious.

In the rejection, the post processing section 31 in Zhang is relied upon as corresponding to the claimed noise suppressing section. However, this disclosure of Zhang fails to address the above-noted deficiencies of Ikeda, and claim 1 differs from the disclosure in Zhang with regard to the manner of providing the noise suppressing section with a signal and in overall operation, including the stage prior to the noise suppressing section, as is discussed below.

In Zhang, post-processing sections 31 and 32 suppress noise components that remain in an error signal el(n) of an adaptive filter 21. (See Figure 3). That is, both the adaptive filter 21 and the post-processing units 31 and 32 suppress noise other than the target sound. In this case, under actual use conditions, the operation of the adaptive filter 21 is disturbed by the direction of the noise source, the number of the noise sources present, movement of the noise source, and other factors, whereby the noise suppression effect changes. Due to this change, the noise components remaining in the error signal el(n) change. As a result, the followability of the noise components estimation in the

post-processing units 31 and 32 becomes problematic. Consequently, the noise suppressing sections of Zhang require three signals (i.e., first signal ml(n), filter output signal yl(n), and error signal el(n)), which complicates the process.

In contrast, in claim 1, the claimed adaptive filter is used to suppress the target sound included in the noise reference signal and only the noise suppressing section suppresses noise other than the target sound. Between the main signal and the noise reference signal of the subtracting section, which is the reference signal of the noise suppressing section, the noise components are not affected by the convergence of the adaptive filter, since the adaptive filter cancels the signal component of the target sound included in the noise reference signal. (See Figure 1 of the present specification). Consequently, the present invention solves the problem of the followability of the noise components estimation in the noise suppressing section. The noise suppressing section suppresses noise based on two signals (i.e., the main signal and the noise reference signal). Additionally, the target sound is determined in one direction also in the convergence of the adaptive filter. Therefore, since the adaptive filter is used to estimate one transfer characteristic, the convergence becomes stabilized. As a result, it is apparent that Zhang fails to address the deficiencies of Ikeda, and the combination of Ikeda and Zhang fails to render claim 1 obvious.

In addition to being patentable over the combination of Ikeda and Zhang due to its dependence on claim 1, claim 2 is patentable over the combination since it recites that the signal generating section includes a first microphone unit positioned so that a main axis of directivity is oriented to the direction of the target sound; and a second microphone unit positioned so that a direction of minimum sensitivity of directivity is oriented to the direction of the target sound.

In the rejection, Ikeda is relied upon as disclosing these features. However, Ikeda only discloses that a microphone by which a speech signal is received is located away from a microphone by which a noise signal is received. That is, Ikeda fails to disclose or suggest that the direction of minimum sensitivity of the directivity of the second microphone unit is oriented to the direction of the target sound. As a result, claim 2 is a patentable over the combination of Ikeda and Zhang.

Claims 5 and 6 have been rejected under 35 U.S.C. §103(a) as being unpatentable over Ikeda in view of Zhang and further in view of Buck (US 7,020,291).

Regarding this rejection, it is noted that claims 5 and 6 are patentable over the combination of Ikeda, Zhang and Buck based on their dependence on claim 1 because Buck fails to disclose or

suggest the above features lacking from Ikeda and Zhang. Further, despite the indication in the rejection, Buck fails to disclose or suggest the amplifying section for amplifying the signal output from the delaying section as recited in claim 5.

Buck discloses in Figure 4a that gain compensation (i.e., Gain) is provided at the stage following a microphone 11 so as to be used to make corrections for equalizing the sensitivity of the microphones. (See column 2, lines 19-22). Therefore, the gain compensation of Figure 4a has the same effect on a main signal P and a reference signal R so as to reduce the sensitivity of the direction of minimum (i.e., null) sensitivity as much as possible. (See Figure 4a).

In contrast, since different signal delays (i.e., ALL) are provided to the different microphone sides (10 or 11), the main signal P is different from the reference signal R in the direction of minimum sensitivity. The minimum sensitivity of the main signal P can only be formed on the back surface (when the direction of the target sound is the front). On the other hand, the minimum sensitivity of the reference signal R can only be formed on the front side (when the direction of the target sound is the front).

In claim 5, the delaying section has the same effect on the main signal and the noise reference signal (see, for example, Figure 16A of the present specification) such that the direction of the minimum sensitivity of the main signal is approximately the same as the direction of minimum sensitivity of the noise reference signal. Since the amplification of the signal output from the delaying section is performed only on the main signal, the amplifying section has an effect only on the main signal such that while the sensitivity of the noise reference signal is completely minimized, the sensitivity of the main signal can be detected. As a result, it is possible to increase the difference in sensitivity between the main signal and the noise reference signal as for the direction of the target sound and decrease the difference in sensitivity for a direction other than the direction of the target sound at the same time. Thus, the gain compensation of Buck (see Figure 4a) is different from the amplifying section as recited in claim 5 in structure, purpose and function. Therefore, the combination of Ikeda, Zhang and Buck fails to render claim 5 obvious.

Claim 11 has been rejected under 35 U.S.C. §103(a) as being unpatentable over Ikeda in view of Zhang and further in view of Yoshida (US 6,404,886). In the rejection, Yoshida is relied upon as disclosing a reflection information calculating and correcting section. However, Yoshida fails to address the above-discussed deficiencies of Ikeda and Zhang with respect to claim 1. Therefore,

claim 11 is patentable over the combination of Ikeda, Zhang and Yoshida based at least on its dependence from claim 1.

Claims 14-17 and 20 have been rejected under 35 U.S.C. §103(a) as being unpatentable over Ikeda in view of Yoshida.

Regarding claim 14, it is patentable over the combination of Ikeda and Yoshida for reasons similar to those set forth above regarding claim 1. That is, claim 14 recites a microphone device including, in part:

a signal generating section for generating a main signal indicative of a result obtained through detection with a sensitivity in a direction of the target sound and a noise reference signal indicative of a result obtained through detection with a sensitivity higher in another direction than in the direction of the target sound by orienting a direction of minimum sensitivity to the direction of the target sound;

an adaptive filter section including an adaptive filter, the adaptive filter section for generating a signal indicative of a signal component of the target sound included in the noise reference signal generated by the signal generating section by subjecting the main signal generated by the signal generating section to a filtering process at the adaptive filter, and for learning a filter coefficient only when the determining section determines that the level ratio is larger than the predetermined value; and

a subtracting section for canceling a signal component of the target sound included in the noise reference signal by subtracting the signal generated by the adaptive filter section from the noise reference signal generated by the signal generating section. This is apparent that these features are not disclosed or suggested in the combination of Ikeda and Yoshida.

Claims 18 and 19 have been rejected under 35 U.S.C. §103(a) as being unpatentable over Ikeda in view of Yoshida and further in view of Buck.

In the rejection, Buck is relied upon as disclosing a signal generating section. However, Buck fails to address the above-discussed deficiencies of Ikeda and Yoshida with respect to claim 14. Therefore, claims 18 and 19 are patentable over the combination of Ikeda, Zhang and Yoshida based at least on their dependence from claim 14.

Claims 27 and 28 have been rejected under 35 U.S.C. 103(a) as being unpatentable over Ikeda in view of Zhang and further in view of Mitsuhashi (US 5,548,335).

This rejection is also respectfully traversed and submitted to be inapplicable to the claims for the following reasons.

Claim 27 is patentable over the combination of Ikeda, Zhang and Mitsuhashi, since claim 27 recites an audio player including, in part:

a signal generating section for generating, based on audio signals recorded on an audio recording section, a main signal indicative of a result obtained through detection with a sensitivity in a direction of a target sound and a noise reference signal indicative of a result obtained through detection with a sensitivity higher in another direction than in the direction of the target sound by orienting a direction of minimum sensitivity to the direction of the target sound;

an adaptive filter section including an adaptive filter, the adaptive filter section for generating a signal indicative of a signal component of the target sound included in the noise reference signal generated by the signal generating section by performing, by the adaptive filter, a filtering process on the main signal generated by the signal generating section, and for learning a filter coefficient only when the determining section determines that the level ratio is larger than the predetermined value;

a subtracting section for canceling a signal component of the target sound included in the noise reference signal by subtracting the signal generated by the adaptive filter section from the noise reference signal generated by the signal generating section; and

a reproducing section for reproducing the main signal with the signal component of the noise being suppressed by the noise suppressing section, wherein

the noise suppressing section includes:

a noise suppression filter coefficient calculating section for calculating, based on a power spectrum of the main signal and a power spectrum of the noise reference signal after subtraction by the subtraction section, a filter coefficient of a noise suppression filter for suppressing the signal component of the noise included in the main signal; and

a time-variant coefficient filter section for causing the main signal to be subjected to a filtering process at the noise suppression filter by reflecting the filter coefficient calculated by the noise suppression filter coefficient calculation section. The combination of Ikeda, Zhang and Mitsuhashi fails to disclose or suggest these features of claim 27.

As noted above in the discussion of claim 1, Ikeda and Zhang fail to disclose or suggest the adaptive filter section and subtracting section as similarly recited in claim 27. Therefore, Mitsuhashi

must disclose or suggest these features in order for the combination of Ikeda, Zhang and Mitsuhashi to render claim 27 obvious.

Regarding Mitsuhashi, it discloses a video camera 110 for removing the effect of an operator's voice on the sound from the subject. In the video camera 110, recording is performed by selecting between first and second microphones 101 and 102. (see Figure 1). The video camera 110 performs audio recording by using only the first microphone 101 or mixing the first and second microphones 101 and 102. (See Figures 3-6). Further, the gain of the first microphone 101 is controlled based on the changes of volume of the first and second microphones. (See Figure 7).

In Mitsuhashi, the output signal from the first microphone 101 can be relied upon as corresponding to the main signal of claim 27 and the output signal from the second microphone 102 can be relied upon as corresponding to the noise reference signal of claim 27. Mitsuhashi does not disclose or suggest that the signal from the first microphone 101 acts on the signal from the second microphone 102. Therefore, it is apparent that Mitsuhashi also fails to disclose or suggest the adaptive filter section and the subtracting section as recited in claim 27. Since Mitsuhashi fails to address the deficiencies of the combination of Ikeda and Zhang, it is submitted that the combination of Ikeda, Zhang and Mitsuhashi fails to render claim 27 obvious.

Additionally, it is noted that withdrawn claims 8-10 and claims 21-23 are entitled to due consideration as being dependent from claim 1 and claim 14, respectively, which are allowable for the reasons set forth above.

Because of the above-mentioned distinctions, it is believed clear that claims 1-11, 13-23, 27 and 28 are allowable over the references relied upon in the rejections. Furthermore, it is submitted that the distinctions are such that a person having ordinary skill in the art at the time of invention would not have been motivated to make any combination of the references of record in such a manner as to result in, or otherwise render obvious, the present invention as recited in claims 1-11, 13-23, 27 and 28. Therefore, it is submitted that claims 1-11, 13-23, 27 and 28 are clearly allowable over the prior art of record.

In view of the above amendments and remarks, it is submitted that the present application is now in condition for allowance. The Examiner is invited to contact the undersigned by telephone if it is felt that there are issues remaining which must be resolved before allowance of the application.

Respectfully submitted,

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